

## MOBILE TERMINAL

### BACKGROUND OF THE INVENTION

#### Field of the Invention

5       The present invention relates to a mobile terminal, and more specifically to a folding mobile terminal in which a 2-axis hinge unit rotatably couples two housings.

#### Description of the Related Art

10       A mobile telephone can be of a straight type, a folding type, etc. Since a folding mobile telephone can be provided with a large liquid crystal display unit, it is widely used by a largenumberofusers. Conventionally, amajorityofthemobile telephones of this type are designed to allow an upper housing  
15       having a display unit and a lower housing having an operation unit to be open and closed to each other. Japanese Patent Application Laid-open No. 11-30226, Japanese Patent Application Laid-open No. 2002-118633, etc. have disclosed a mobile telephone in which a 2-axis hinge unit rotatably couples two housings.  
20       With the mobile telephone of this type, an upper housing can be rotated and be folded. Therefore, when the mobile telephone is folded, the display unit can be arranged outside. However, the mobile telephone normally has its key operation unit in the lower housing. Therefore, although the folded mobile telephone  
25       has its display unit facing outside, it is not possible to operate the key operation unit in the lower housing. A pointing device occupies a large area of the key operation unit. However, since

the upper housing is occupied by a large display unit, it is hard to arrange the pointing device in the upper housing.

#### SUMMARY OF THE INVENTION

5        The mobile terminal according to an embodiment of the present invention includes a control unit for controlling a terminal, a display unit, an upper housing, a lower housing, and a 2-axis hinge unit for coupling the housings. A part of the 2-axis hinge unit is exposed to the outside of the terminal, and input means  
10    is mounted in the exposed portion. The control unit can control the terminal by operating the input means. The input means can be, for example, a pointing device. The mobile terminal can include position detection means for detecting the relative positions between the upper housing and the lower housing. The  
15    control unit can control the terminal based on the output of the position detection means. The input means can be a fingerprint sensor. The control unit can control the terminal based in the input from the fingerprint sensor. The terminal can also include a lock unit for locking the 2-axis hinge unit.  
20    The lock unit can lock the folded terminal by the input of the fingerprint sensor. When the mobile terminal is folded, the mobile terminal can be controlled through the input means. Furthermore, predetermined operations such as a pointing operation on the display unit arranged on the surface of the  
25    folded terminal, etc. can be performed.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will become apparent from the following detailed description when taken with the accompanying drawings in which:

5        FIGS. 1A, 1B, and 1C are plan views according to an embodiment of the mobile terminal of the present invention;

      FIGS. 2A and 2B are plan views according to an embodiment of the mobile terminal of the present invention;

10       FIG. 3 is a perspective view showing an embodiment of the 2-axis hinge unit of the present invention;

      FIGS. 4A, 4B, and 4C are plan views showing the arrangement of the magnetic sensor and the magnet arranged on the mobile terminal of the present invention;

15       FIG. 5 is a block diagram showing an embodiment of the mobile terminal according to the present invention;

      FIG. 6 is a flowchart showing an example of the operation of the mobile terminal according to the present invention;

20       FIG. 7 is a flowchart showing another example of the operation of the mobile terminal according to the present invention; and

      FIG. 8 is a flowchart showing another example of the operation of the mobile terminal according to the present invention.

## 25       DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An example of a mobile telephone is described below as a folding mobile terminal according to the present invention. FIGS. 1A, 1B, 1C, 2A, and 2B show examples of arranging the upper

housing and the lower housing on the 2-axis hinge unit. In FIG. 1A, an upper housing 200 including a display unit 202 is opened, and an operation key unit 102 and other units are arranged in the lower housing. FIG. 1B shows the closed upper housing 200 overlaid on a lower housing 100. FIG. 1C shows the case in which the upper housing 200 is 180° turned from the position shown in FIG. 1A. FIG. 2A shows the case in which the upper housing 200 is 90° turned from the position shown in FIG. 1A along the lower housing 100. FIG. 2B shows the case in which the upper housing 200 is further turned from the position shown in FIG. 2A, and overlaid on the lower housing 100.

The upper housing 200 of the mobile telephone of the above-mentioned example includes the display unit 202, an ancillary operation key 204, and a speaker 203. The lower housing 100 includes the operation key unit 102, a microphone 103, and a secondary operation key 104. A 2-axis hinge unit 300 couples these two housings. The two housings can be folded and be turned. A pointing device 320 is arranged at the end of the 2-axis hinge unit 300. The pointing device 320 is constantly exposed to the outside of the mobile telephone regardless of the position of the housings. The operations selected by the pointer on the display unit 202 can be performed by pressing the pointing device 320.

FIG. 3 shows an embodiment of the 2-axis hinge unit. The 2-axis hinge unit 300 includes a first metal rotation axis (hereinafter referred to as a horizontal rotation axis) 301 and a second metal rotation axis (hereinafter referred to as an open/close rotation axis) 302. The open/close rotation axis

302 is arranged in the upper housing 200. The pointing device 320 is arranged at the end of the horizontal rotation axis 301. A metal substrate 304 holds the horizontal rotation axis 301. The lower portion of the horizontal rotation axis 301 and the substrate 304 are arranged in the lower housing 100. The open/close rotation axis 302 has two coil springs 305. Circular click plates 306 are attached to both ends of the open/close rotation axis 302. End portions 303a of a bracket unit 303 are connected to both ends of the open/close rotation axis 302. The bracket unit 303 has a through-hole 303b, and is fixed to the substrate 304 with a bolt.

The horizontal rotation axis 301 and the open/close rotation axis 302 are independently turned in a predetermined range. The horizontal rotation axis 301 turns within the range of  $\pm 180^\circ$ . The open/close rotation axis 302 turns within the range from  $0^\circ$  to  $180^\circ$ . The turn is restricted by a stopper. Described below is the stopper mechanism of the horizontal rotation axis 301. The substrate 304 has a guide rod 304a. The guide rod 304a is provided with a stopper 307. The stopper 307 can slide along the guide rod 304a. The horizontal rotation axis 301 has a projection at the lower portion. The projection turns with the horizontal rotation axis 301. The projection touches the stopper 307, and the upper housing 200 stops. In another example, two projections can be formed. One projection is used for a clockwise turn, and the other for a counterclockwise turn. After the upper housing 200 turns by  $90^\circ$ , it is desired that the housing 200 is gently fixed. A stopper which gently fixes it can be arranged. The stopper mechanism (hereinafter referred to as

a click mechanism) of the open/close rotation axis 302 is described below. When the upper housing 200 is coming close a predetermined open position or a predetermined closed position, the click mechanism generates a torque for these positions. The  
 5 click mechanism also generates a torque for holding the upper housing 200 in these positions. The click mechanism according to the present embodiment includes the click plate 306 having a projection, a groove portion 308 formed in the bracket unit 303, and a coil spring 305 for generation of a torque for the  
 10 click plate. The projection is formed outside the click plate 306. The bracket unit 303 has the groove portion 308 in its inner surface. The groove portion 308 is engaged with the projection on the click plate 306 in the predetermined positions. In the position of the groove portion 308, the upper housing  
 15 200 is temporarily fixed. The coil spring 305 pushes the click plate 306 against the bracket unit 303. The configuration of the 2-axis hinge unit is not limited to the configuration of the present embodiment.

The electrical connection between the upper housing and  
 20 the lower housing is formed in a known method. For example, it is possible to arrange flexible wiring inside the horizontal rotation axis and the open/close rotation axis. Otherwise, a film of a flexible printed circuit (FPC) can be arranged around the rotation axes.

25 FIGS. 4A, 4B, and 4C show the mechanisms of detecting the relative positions between the upper housing 200 and the lower housing 100. In FIG. 4A, the lower housing 100 has four Hall element (magnetic sensors) 111a to 111d. The magnetic detection

unit with the Hall element faces the surface of the lower housing 100 on which the operation key, etc. is arranged. The Hall elements 111a, 111b, and 111d are located on the arc of a predetermined radius centered on the horizontal rotation axis 301. The Hall device 111d is located on the center axis of the lower housing 100. The Hall elements 111a and 111b are located at the positions of a  $45^\circ$  from the center axis. Around the end portion of the lower housing, the Hall element 111c is arranged. Each of the above-mentioned Hall elements can detect the direction of the magnetic field of a magnet. In FIG.4B, the upper housing 200 has a semicircular magnet 204a in the corresponding positions of the Hall elements 111a, 111b, and 111d. Around the end portion of the upper housing 200, a magnet 204b is mounted. The position of the magnet 204b corresponds to the position of the Hall element 111c. Three magnets can be arranged in the positions corresponding to the Hall elements 111a, 111b, and 111d. FIG.4C shows an example of the relative position between the Hall element and the magnet. In this example, the upper housing 200 is parallel to the lower housing 100. When the upper housing 200 is folded and overlaid on the lower housing 100, the magnet 204a is located in the position Lo1. In this case, all of the Hall elements 111a, 111b, and 111d detect magnets. If the upper housing 200 turns clockwise by  $90^\circ$ , the magnet 204a is located in the position Lo2. In this case, only the Hall element 111b detects a magnet. If the upper housing 200 further turns clockwise by  $90^\circ$ , then the magnet 204a is located in the position Lo3. In this case, no Hall elements detect a magnet. As described above, the position of the upper housing can be

determined based on the output of the Hall elements. When the upper housing 200 and the lower housing 100 are folded and the display unit 202 is arranged outside the telephone, the Hall element 111c is located in the position Lo4. In this case, the Hall element 111c detects the magnet 204b. When the upper housing 200 and the lower housing 100 are folded and the display unit 202 is arranged inside the telephone, the Hall element 111c is located in the position Lo4'. In this case, the Hall element 111c does not detect the magnet 204b. Therefore, when the housings are folded, the position of the display unit 202 is determined based on the output of the Hall element 111c.

FIG. 5 is a block diagram showing an embodiment of the present invention. The upper housing 200 has the magnets 204a and 204b. The lower housing 100 has the Hall elements 111a to 111d. A relative position detection unit 101 detects the relative positions between the upper housing 200 and the lower housing 100 based on the outputs of the Hall elements 111a to 111d. The lower housing 100 has an operation key 107, a reception detecting unit 106, a hinge lock unit 310, and an inputting operation device (for example, a pointing device) 320. A control unit 105 controls the pointing device 320, the operation key 107, the hinge lock unit 310, and the entire telephone. The pointing device 320 can be used as an operation button (for example, a scroll button, a camera button, etc.).

The control unit 105 can enable or disable an inputting operation of the pointing device 320 based on the output of the relative position detection unit 101. For example, when the upper housing 200 and the lower housing 100 are folded and the



display unit 202 is arranged inside the telephone, the control unit 105 can disable an inputting operation of the pointing device 320.

FIG. 6 shows the above-mentioned control flow. First, the change in the relative positions of the housings is detected (S101). When the housings are overlaid with each other with the display unit 202 facing inside (YES in S102), the control unit 105 disables the inputting operation of the pointing device 320 (S104). When the housings are open (NO in S102), the control unit 105 determines whether or not the display unit 202 faces outside (S103). If the display unit 202 faces outside (YES in S103), the control unit 105 enables the inputting operation of the pointing device 320. At this time, the input of the pointing device 320 is converted left to right (S105). When the display unit 202 faces inside (NO in S103), the control unit 105 enables the inputting operation of the pointing device 320.

In FIG. 7, when the control unit 105 detects the inputting operation of the secondary operation key 104 and the pointing device 320, the control unit 105 can enable or disable the operation of the pointing device. The control unit 105 detects the operation of the pointing device 320 (S203), and simultaneously detects the presence/absence of the operation of the key 104 (S204). When the secondary operation key 104 is operated (YES in S204), the control unit 105 enables the operation of the pointing device 320 (S205). When the key 104 is not operated (NO in S204), the control unit 105 disables the operation of the pointing device 320 (S205). An erroneous inputting operation of the pointing device 320 can be prevented.

In FIG.8, the control unit 105 can detect the displacement direction (for example, the rotation direction) of the upper housing 200 and the lower housing 100 and can set the function of the pointing device. The control unit 105 detects the relative position of the housings (S301). The control unit 105 detects that the housings are overlaid with each other, and the display unit 202 is arranged outside of the telephone (YES in S302). At this time, if the upper housing 200 turns clockwise and is overlaid on the lower housing 100 (YES in S303), then the control unit 105 changes the display unit 202 into the vertically oriented screen and changes the function of the pointing device 320 (S304). If the upper housing 200 turns counterclockwise and is overlaid on the lower housing 100 (YES in S305), then the control unit 105 changes the display unit 202 into the horizontally oriented screen and changes the function of the pointing device 320 (S306). When the upper housing 200 turns otherwise, the control unit 105 does not change the function of the pointing device 320 (S307). In the case above, the browsing mode is set on the vertically oriented screen. The pointing device is used in switching the page of the displayed information. The contents playback mode (for example, the digital terrestrial receive mode) is set on the horizontally oriented screen. The pointing device 320 has the function of as the operator for adjusting the quality of an image and voice of the contents to be played back.

The control unit 105 can provides functions for a specific operation for the pointing device 320. For example, during transmitting, a user can operate the pointing device to start communications, or control the calling tone. Furthermore, the

user can operate the pointing device 320 to function or release the hinge lock unit 310.

A physical value detection device (for example, a personal authentication sensor, etc.) can be arranged at the end portion  
5 of the 2-axis hinge unit. As an example of the sensor, a fingerprint recognition device can be mounted. According to the input information into the fingerprint recognition device, the hinge lock unit 310 can be controlled. Inputting a fingerprint recorded in advance can activate or release the hinge  
10 lock unit 310. The control unit 105 can request inputting a fingerprint and simultaneously performing other key operation. When a fingerprint recorded in advance is input, the control unit 105 can use the terminal. The above-mentioned control can protect the mobile telephone against an unauthorized use.

15 With the folding mobile terminal according to the present invention, for example, a pointing device can be mounted at the end portion of the 2-axis hinge unit which is constantly exposed outside, thereby realizing a smaller terminal.

While the present invention has been described in connection  
20 with certain preferred embodiments, it is to be understood that the subject matter encompassed by the present invention is not limited to those specific embodiments. On the contrary, it is intended to include all alternatives, modifications, and equivalents as can be included within the spirit and scope of  
25 the following claims.